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A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
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U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie, Manager, Oak Ridge Operations

Gentlemen:

Information on Waste Disposal

OK

Attached is the document KB-645 comprising information requested in the letter OR:HMR, S. R. Sapirie to C. E. Center, January 11, 1957.

Very truly yours,

UNION CARBIDE NUCLEAR COMPANY

D M Lang

for L. B. Emlet, Manager of Production

LBE:JHJ:rl

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KB-645

RHTG 32,918

BOX # #67

INFORMATION ON WASTE DISPOSAL

The status of operations for the disposal of waste uranium and waste uranium compounds, and the future outlook in this area, are presented separately for the three production facilities. In the summaries which follow, the items of information are submitted in the same order as listed in the request. The volumes, radioactivities, and compositions represent the best currently available estimates derived on the bases indicated in the text.

For the purposes of this communication, the term "waste" is defined as contaminated material containing insufficient relative quantities of uranium to warrant recovery. Processes for recovering material for recycling in the production units are not considered here. The removal of material from any waste stream for the purpose of maintaining acceptable health hazard standards is considered within the scope of waste disposal.

A. Waste Disposal at the Oak Ridge Gaseous Diffusion Plant

1. Liquid waste is discarded, almost entirely, on a continuous basis, hence there is no inventory.

2. Future storage of liquid waste is not anticipated for the reason given in item 1.

3. Liquid waste discarded prior to the calendar year 1957 is estimated to total 25 million gallons*, containing approximately 150 kilograms uranium. Practically all of this was from decontamination operations, and assays for practical purposes less than 2% U-235, although gram quantities may go to more highly enriched levels**. The discard flows, consisting of raffinate, condensate, waste acid, and rinse water, pass through a settling basin where most of the uranium burden deposits out in the silt. The overflow from the settling basin is discharged into an off-area flowing stream (Poplar Creek). Downstream from the plant premises, experience has shown this stream to contain approximately 4 parts per billion uranium. Part of the Poplar Creek burden does not, however, originate at the ORGDP.

*For the early operation of this plant, prior to 1950, estimated discard volumes have been derived on the basis of more recent experience.

**The levels of radioactivity are not known; in lieu of this, estimated uranium content and U-235 assay are provided.

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[redacted] RESTRICTED DATA
This documen[redacted]ontains restricted data as defined [redacted] the Atomic Energy Act of 1954. Its [redacted]smittal or the disclosure of its contents in any [redacted]nner to an unauthorized person is prohibited.

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Classification Changed to UNCLASSIFIED
By Authority of PG-D-4 / W-5
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By R. B. Martin, Analysas Corp. 2-28-89
Date
10-6-89

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M.R. Thelson, EASI JAN. 27 1997
Date

4. Future discards of liquid waste are expected to be about 9,000,000 gallons per year, containing 60 kilograms uranium of approximately the same U-235 assay range described in item 3. This flow will pass through the settling basin, as noted in item 3, and should not result in an appreciable increase in the uranium content of the off-area effluence.

5. There are no liquid waste tank storage facilities and none are planned.

6. The only costs of consequence incurred in waste disposal at this plant are associated with routine monitoring of the settling basin and Poplar Creek, and the analysis of samples representing batch discards. These costs amount to approximately $2,000 per year.

7. No research or development work on waste disposal problems is being performed.

8. The problem of separating fission products is not encountered at this plant.

9. Small quantities of below-natural uranium hexafluoride in the gas phase are vented to atmosphere in the course of feed plant operations. The major source of release occurs in the processing of uranium tetrafluoride to uranium hexafluoride. The hexafluoride is removed by condensation in refrigerated traps for subsequent transfer to shipping containers. A small portion of the hexafluoride, however, does not condense but is carried through the traps to the atmosphere with a flow of lighter gases (nitrogen, oxygen, and a small quantity of fluorine) which must be vented. In this manner approximately 23 kilograms uranium hexafluoride per month is released with stack gases to the atmosphere. The annual cost of monitoring this flow is $2,000.

10. No facilities for the disposal of solid waste currently exist at this plant. When the need arises, waste material in this form is transported to the Oak Ridge National Laboratory burial location. Recent experience indicates this disposal flow to be approximately 3,000 pounds total solids containing 15 kilograms uranium per month. Annual transportation costs are estimated to be $1,000.

B. Waste Disposal at the Paducah Plant

1. The liquid waste presently in storage has a volume of approximately 2,600,000 gallons, based on the dimensions of the holding pond and contains about 54 kilograms uranium of 0.66 weight per cent U-235. The total uranium is based on the uranium content of the holding pond

effluent as stated in KYB-31[1]. The assay is an estimate based on the fact that better than 98% of the material handled in the present feed plant is reactor tails material.

2. The present holding pond will adequately serve the future storage needs. It is anticipated that the present volume, total uranium throughput, and assay will hold true for the forseeable future.

3. The total volume of liquid waste disposed to the environment to date is not known; however, an estimated 2,775 kilograms uranium of 0.46 assay has been discarded. This information is obtained from KYD-645, Part 6[2].

4. It is estimated that future liquid waste disposed to the environment will approximate the rate listed in table 2 of KA-485[3], that is, 69,000 gallons per month containing 49 kilograms uranium with an average estimated 0.66 weight per cent U-235.

5. The Paducah plant has no tank storage facilities for liquid waste; the holding pond serves as the only storage facility. The need for additional capacity is not anticipated.

In all of the above items, where total radioactivity was requested, the uranium and U-235 content were substituted, because of lack of the specific information. However, some estimates of the radioactivity discharged to the environment can be found in KYB-31[1]. The chemical composition of current and future liquid-waste material can be characterized by reference to the various sources of this material. Much of this stream is composed of TBP extraction column raffinate containing nitrates and fluorides of various metallic impurities, such as sodium, aluminum, iron, copper, and nickel and filtrate from ammonium hydroxide precipitation which contains various anions. This total decontamination and recovery area effluent is diluted by ground water and miscellaneous waste streams which do not contain uranium.

6. The present cost of sampling and analytical work associated with monitoring the environment for uranium and radioactivity is approximately $500 per year. This is the total cost assigned to liquid waste disposal. The somewhat expanded program in this area, described in KYB-31[1], will cost an estimated $1,000 per year.

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[1] Brown, E. G., Waste Disposal Survey and Monitoring Proposal for the Paducah Plant, Union Carbide Nuclear Company, Paducah Plant, January 17, 1957 (KYB-31).

[2] Fortune, M. B., Cumulative Uranium and U-235 Book-Physical Inventory Differences through December 31, 1956, Union Carbide Nuclear Company, Paducah Plant, January 24, 1957 (KYD-645).

[3] Center, C. E., S.S. Materials Removed from Inventory, Union Carbide Nuclear Company, December 19, 1956 (KA-485).

7. The Paducah plant has no research and development program for waste disposal.

8. There is no program for separating fission products at the Paducah plant, although fission products are separated incidental to the production of uranium hexafluoride in the C-410 tower reactors. This tower ash is recycled to recover contained uranium tetrafluoride. Eventually, however, some of the fission products are discarded to the holding pond.

9. The procedure for trapping the uranium hexafluoride produced in the Paducah feed plant is approximately the same as described in item 9 for the ORGDP. This operation releases approximately 350 kilograms uranium hexafluoride per month to the atmosphere(3). Recovery of this material is planned (see paragraph 2 of this report for distinction between recovery and waste disposal).

10. The Paducah plant uses a hot-salvage yard, approximately 250 x 600 feet, for storage of contaminated equipment and trap materials from which it is uneconomical to recover the uranium. There is little or no cost for maintaining this facility, and the only operating cost is that involved in transporting the contaminated items to the yard. In addition, there are about eighteen old Kentucky Ordnance Works igloos within the proposed future AEC property line north of the plant site which will be used for storage of waste uranium bearing solids from the Metals Plant. Each igloo has about 14,500 cubic feet of usable storage space. The solids which will be stored here contain quantities of very low assay uranium which presently have little or no book value and hence, will not be recovered. However, this material will form a readily available source of low assay uranium should it ever become economical to recover. No plant and operating cost estimates are available at this time, since there has been no operating experience.

C. Waste Disposal at the Y-12 Plant

1. All liquid waste storage is in the form of open pits. Volumes are presented in table I, and total radioactivity and chemical composition are given in table II.

2. Approximately 6,000,000 gallons of the composition indicated in table I are estimated as requiring storage over the next five years.

3. Uranium losses from the Y-12 plant to the environment from August 1943 to May 1956 were previously reported in table I, KB-595(4). This information has been updated to January 1, 1957, and together with five years projection of such losses is included herein as table III.

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(3) Ibid.

(4) Emlet, L. B., letter to S. R. Sapirie, Information Desired by Project Crave, Union Carbide Nuclear Company, June 22, 1956 (KB-595).

The sewered liquid wastes are drained by the storm sewer system into Poplar Creek as outlined in the text of KB-595. Although the volume and total radioactivity of these wastes are unknown, Poplar Creek has been monitored over the past six years. The results of the samples taken have shown the creek to be below the allowable activity tolerance for uranium release to an uncontrolled environment.

4. A five-year projection on liquid waste is included in table III.

5. All liquid storage is in open pits. As noted in table I, this storage is estimated to be adequate for five additional years. The installation costs of these pits, including pipeline and pumps, was $65,000 in 1952. Operating costs are estimated as $6,000 per year.

6. Over-all costs for waste disposal including environmental monitoring are summarized as follows:

Item	Cost/Year
Liquid Storage Pits	$ 6,000
Burial Grounds	32,000*
Environmental Monitoring	30,000
Total	$68,000

7. No program of waste disposal research and development is currently active at Y-12. Periodic reviews of progress at AEC research sites such as ORNL are made.

8. Fission product separation work is not conducted.

9. No radioactive gaseous waste disposal operations are performed at Y-12. Information on vent losses are included in table III.

10. The disposal of solid wastes at the Y-12 plant is limited to contaminated material of low activity. Higher activity waste from the Y-12 plant is buried at the ORNL facility.

The low activity solid wastes are buried in trenches in the west portion of the Y-12 plant area. The operating costs for burial of Y-12 wastes at ORNL were approximately $4,000 for FY-1956 and $6,000 for the first half of FY-1957. The costs for solid waste disposal at Y-12 were approximately $14,000 for FY-1956 and $10,000 for the first half of FY-1957. The cost of preparing trenches has averaged $3,000 per year.

*The burial ground costs are on the basis of an extrapolation of the costs for the first half of FY-1957 to an annual basis.

TABLE I

LIQUID WASTE STORAGE AT THE Y-12 PLANT

Item	Total Capacity, Gallons	Presently in Storage, Gallons	Remaining Capacity, Gallons	Estimated Remaining Time to Fill, Years
Northeast Open Pit	2,859,000	2,423,000	436,000	
Northwest Open Pit	3,117,000	1,298,000	1,819,000	
Southeast Open Pit	2,897,000	504,000	2,393,000	
Southwest Open Pit	2,782,000	536,000	2,246,000	
Total	11,655,000	4,761,000	6,894,000	5

[redacted]

TABLE II

CHEMICAL COMPOSITION* AND RADIOACTIVITY OF LIQUID STORAGE AT THE Y-12 PLANT

	Northeast Open Pit		Northwest Open Pit		Southeast Open Pit		Southwest Open Pit	
	Liquid	Solids from Bottom	Liquid	Solids from Bottom	Liquid	Solids from Bottom	Liquid	Solids from Bottom
Ag	0.01	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Al	1.6	17.5	0.45	19.4	0.83	19.4	0.16	17.5
Au	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02
B	<0.001	0.01	<0.001	0.01	<0.001	0.01	<0.001	<0.01
Ba	<0.001	0.01	<0.001	0.024	<0.001	0.008	0.001	0.01
Be	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bi	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Ca	0.4	0.08	0.09	0.15	0.23	0.29	0.024	0.05
Cd	<0.001	<0.04	<0.001	<0.04	<0.001	<0.04	<0.001	<0.04
Co	0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Cr	0.002	0.015	0.0003	0.01	0.003	0.01	0.0001	0.01
Cs	<0.02	<0.3	<0.02	<0.3	<0.02	<0.3	<0.02	<0.3
Cu	0.01	0.008	0.001	0.01	0.007	0.015	0.0012	0.003
Fe	0.06	5.8	0.03	7.8	0.02	3.9	0.005	6.8
Hf	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02
In	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
K	0.04	1.9	0.015	2.9	0.03	1.9	0.0006	1.45
Li	0.001	0.005	0.0006	0.01	0.0003	0.005	0.0006	0.005
Mg	0.8	0.97	0.2	1.5	0.4	0.58	0.08	0.97
Mn	0.002	0.02	0.004	0.008	0.002	0.02	0.01	0.04
Mo	<0.001	0.004	<0.001	0.002	<0.001	0.004	<0.001	<0.002
Na	1	0.24	0.15	0.29	0.4	0.29	0.024	0.1
Nb	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02
Ni	0.004	0.03	0.0009	0.03	0.005	0.03	0.0002	0.03
P	<0.06	<1	<0.06	<1	<0.06	<1	<0.06	<1
Pb	0.001	<0.02	0.0003	<0.02	0.0007	<0.02	<0.001	0.07
Pd	<0.001	<0.002	<0.001	<0.002	<0.001	<0.002	<0.001	<0.002
Pt	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02
Rb	<0.05	<0.08	<0.05	<0.08	<0.05	<0.08	<0.05	<0.08
Sb	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02	<0.001	<0.02
Si	0.02	17.5	<0.001	14.6	<0.001	15.5	0.002	14.6
Sn	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Ta	<0.005	<0.08	<0.005	<0.08	<0.005	<0.08	<0.005	<0.08
Ti	<0.001	0.97	<0.001	0.97	<0.001	1.2	<0.001	0.97
U	0.034	0.0079	0.0011	0.0020	0.036	0.031	0.0002	0.0012
V	<0.001	0.007	<0.001	0.007	<0.001	0.007	<0.001	0.006
W	<0.002	<0.04	<0.002	<0.04	<0.002	<0.04	<0.002	<0.04
Zn	0.02	<0.08	0.005	<0.08	0.02	<0.08	0.0006	<0.08
Zr	0.0003	0.01	<0.001	0.008	0.002	0.02	<0.001	0.005
Alpha**	400	320	68	148	364	266	80	320
Beta	512	974	854	888	1606	958	86	42

*Chemical composition is expressed in per cent of original sample for liquid samples and in per cent of dried solids for solid samples. All chemical compositions were determined spectrographically except uranium.

**The alpha and beta activities are on the basis of disintegrations per minute per milliliter in the case of liquid samples and as disintegrations per minute per gram in the case of solid samples.

[redacted]

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TABLE III

URANIUM LOSSES FROM THE Y-12 PLANT TO THE ENVIRONMENT

Source	Period	Uranium, kg.	Basis for Estimate	Isotopic Composition, Per Cent U-234	U-235	U-236
Alpha Process	1943 to 1945	40,000	Estimated from known losses and unaccounted-for material	0.005	0.65	0
Beta Process	1944 to 1947	400	Estimated from known losses and unaccounted-for material	0.7	23.5	0
Product Processing						
A. Building 9206, Beta Product	1944 to 1947	0.4	Estimated from unaccounted-for material	1	80	0
B. Building 9212						
1. Process Vents from UF_6 Reduction, D-wing	1954 to 1957 1957 to 1962	0.4 1	Estimated from a study of the composition of vent gases, and operating experience	1 1	93 93	0.3 to 0.4 0.3 to 0.5
2. Process Vents from UF_4 Preparation by Batch Process	1945 to 1952 1953 to 1957 1957 to 1962	0.5 2 5	Estimated from a study of the composition of vent gases	1 1 1	93 93 93	0 to 0.1 0.2 to 1.0 0.2 to 1.0
3. Discards from Chemical Processing to Sewer	1953 to 1957 1957 to 1962	6 15	Accountability and operating records used as basis	1 1	93 93	0.4 0.4
4. Air borne Ventilation Losses from Product Processing	1945 to 1952 1953 to 1957 1957 to 1962	1.7 2.2 5	Estimated from an analysis of air sample data	1 1 1	93 93 93	0 to 0.1 0.2 to 0.5 0.2 to 0.5
5. Losses Outside Plant Area on Shoes and Clothing	1945 to 1957 1957 to 1962	1 1	Estimated as order of magnitude	1 1	93 93	0 to 1.0 0 to 1.0
Intermediate Assay Processing, Building 9206						
A. Process Vents from UF_4 Preparation	1955 to 1957 1957 to 1962	0.15 0.4	Estimated from a study of the composition of vent gases, and operating experience	0.2 0.2	37.5 37.5	0.31 0.31
B. Airborne Ventilation Losses	1955 to 1957 1957 to 1962	0.8 2	Estimated from operating experience in similar operations	0.2 0.2	37.5 37.5	0.31 0.31
C. Airborne Salvage Area Losses	1946 to 1952 1953 to 1957 1957 to 1962	0.8 7 17	Estimated	0 to 0.1 0.to 0.1 0 to 0.1	2 2 2	0 to 0.25 0 to 0.25 0 to 0.25
D. Discards from Chemical Processing to Storm Sewer	1946 to 1952 1953 to 1957 1957 to 1962	2.1 15.5 30	Accountability records used as basis	0 to 0.1 0.2 0.2	2 24 24	0 to 0.25 0.2 0.2
E. Accidental UF_6 Releases to the Atmosphere	May 11, 1956 September 19, 1956	2 6	Measured by difference after clean-up	0.2 0.2	37.5 37.5	0.36 0.34
F. Losses Outside Plant Area on Shoes and Clothing	1946 to 1957 1957 to 1962	0.5 0.5	Estimated as an order to magnitude	0.4 0.4	20 20	0 to 0.3 0 to 0.3
Normal and Depleted Assay Processing						
A. Building 9212						
1. Airborne Ventilation and Hood Discharge	1948 to 1954	1,500	Estimated from unaccounted-for losses	0.002 to 0.005	0.4 to 0.7	0 to 0.01
2. Airborne Ventilation and Hood Discharge	1954 to 1957	5,000 to 10,000	Estimated from present recovery figures. (Loss since 7/1/55 is approximately 0.1 kg./day)	0.002	0.2 to 0.4	0.01
3. Airborne Ventilation and Hood Discharge	1957 to 1962	500	Estimated as 0.25 kg./day	0.002	0.2 to 0.4	0.01
B. Building 9206						
1. Combustible Salvage Burning	1948 to 1955	3,200	Estimated from operating experience	0.002 to 0.005	0.15 to 0.7	0 to 0.01
2. Discards from Salvage to Sewer	1946 to 1957 1957 to 1962	2,000 5,000	Accountability records used as basis	0.002 to 0.005 0.002	0.2 to 0.6 0.2 to 0.4	0 to 0.01 0.01
3. Chip Crushing Flush to Sewer	1955 to 1957 1957 to 1962	60 150	Estimated from operating experience	0.002 0.002	0.2 to 0.4 0.2 to 0.4	0.01 0.01
C. Building 9211						
1. Airborne Salvage Burning and Kiln Losses	1953 to 1957 1957 to 1962	130 300	Estimated to December 1955: calculated from effluent analysis December 1955 to date	0.002 to 0.015 0.002 to 0.015	0.2 to 0.8 0.2 to 1.0	0.01 0.01
2. Airborne Ventilation Losses	1953 to 1957 1957 to 1962	10 25	Estimated from operating experience	0.002 to 0.015 0.002 to 0.015	0.2 to 0.8 0.2 to 0.8	0.01 0.01
3. Discards to Sewer	1953 to 1957 1957 to 1962	1,400 3,000	Accountability records used as basis	0.002 to 0.015 0.002 to 0.015	0.2 to 0.6 0.2 to 0.6	0.01 0.01
Discharge to Pit and Burial Grounds, Including X-10 Burial Ground	1943 to 1957	70,000	Accountability and operating records used as basis	0.002 to 1.0	0.1 to 93 av. 0.2 to 0.3	0 to 0.40

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